was charged with a solution of potassium bichromate, another with copper ammonium sulphate solution, and the third with pure water, and all were exposed to sunlight for four hours. The deal in the red light gave only a faint picture, that in the blue light a dark picture, and that with the pure water was only a slightly darker picture. Resin, guaiacum, copal varnish, white oil paint and resin sized paper all acted in the same way and gave similar results.

The light from an arc lamp when passed through a red glass and allowed to fall on a wood section for one and a half hours produced no effect, but when the same light was passed through a blue glass and fell on a similar wood section for only one hour it produced a dark picture. With liquids this same increase of activity by the action of blue light is produced. Turpentine, which has been exposed to blue light, is more active than when in its ordinary condition.

THE DENSITY OF NITROUS OXIDE.[1]

IN the *Proceedings,* vol. lxxii. p. 204, 1897,[2] I have given particulars of weighings of nitrous oxide purified by two distinct methods. In the first procedure, solution in water was employed as a means of separating less soluble impurities, and the result was 3·6356 grams. In the second method a process of fractional distillation was employed. Gas drawn from the liquid so prepared gave 3·6362. These numbers may be taken to represent the corrected weight of the gas which fills the globe at 0° C. and at the pressure of the gauge (at 15°), and they correspond to 2·6276 for oxygen.

Inasmuch as nitrous oxide is heavier than the impurities likely to be contained in it, the second number was the more probable. But as I thought that the first method should also have given a good result, I contented myself with the mean of the two methods, viz. 3·6359, from which I calculated that, referred to air (free from H_2O and CO_2) as unity, the density of nitrous oxide was 1·52951.

The corresponding density found by M. Leduc is 1·5301, appreciably higher than mine; and M. Leduc argues that the gas weighed by me must still have contained one or two thousandths of nitrogen.[3] According to him the weight of the gas contained in my globe should be 3·6374, or 1·5 milligrams above the mean of the two methods.

Wishing, if possible, to resolve the question thus raised, I have lately resumed these researches, purifying the nitrous oxide with the aid of liquid air kindly placed at my disposal by Sir J. Dewar, but I have not succeeded in raising the weight of my gas by more than a fraction of the discrepancy (1·5 milligrams). I have experimented with gas carefully prepared in the laboratory from nitrate of ammonia, but as most of the work related to material specially supplied in an iron bottle I will limit myself to it.

There are two ways in which the gas may be drawn from the supply. When the valve is upwards, the supply comes from the vapourous portion within the bottle, but when the valve is downwards, from the liquid portion. The latter is the more free from relatively volatile impurities, and accordingly gives the higher weight, and the difference between the two affords an indication of the amount of impurity present. After treatment with caustic alkali and sulphuric acid, the gas is conducted through a tap, which is closed when it is desired to make a vacuum over the frozen mass, and thence over phosphoric anhydride to the globe. For the details of apparatus, &c., reference must be made to former papers.

The first experiment on July 13 was upon gas from the top of the bottle as supplied, and without treatment by liquid air, with the view of finding out the worst. The weight was 3·6015, about 35 milligrams too light. The stock of material was then purified, much as in 1896. For this purpose the bottle was cooled in ice and salt[4] and allowed during about one hour to blow off half its contents, being subjected to violent shaking at frequent intervals. Subsequently three weighings were carried out with gas drawn from the bottom, but without treatment by liquid air. The results stand:—July 18, 3·6368; July 20, 3·6360; July 25, 3·6362; mean, 3·63633.

Next followed experiments in which gas, still drawn from the bottom of the bottle, was further purified by condensation with liquid air. On one occasion (August 7) the condensed gas was allowed to *liquefy*, for which purpose the pressure must rise to not far short of atmospheric, and to blow off part of its contents:—August 1, 3·6363; August 3, 3·6367; August 7, 3·6366; mean, 3·63653.

The treatment with liquid air raised the weight by only 0·2 milligram, but the improvement is probably real. That the stock in the bottle still contained appreciable impurity is indicated by a weighing on August 13, in which without liquid air the gas was drawn from the *top* of the bottle. There appeared, August 13, 3·6354, about 1 milligram short of the proper weight.

It will be seen that the result without liquid air is almost identical with that found by the same method in 1896, and that the further purification by means of liquid air raises the weight only to 3·6365. I find it difficult to believe that so purified the gas still contains appreciable quantities of nitrogen.

The corresponding weight of air being 2·3772,[1] we find that, referred to air as unity, the density of nitrous oxide is $3{\cdot}6365/2{\cdot}3772=1{\cdot}5297$. Again, if oxygen be taken as 16, the density of nitrous oxide will be $3{\cdot}6365\times16/2{\cdot}6276=22{\cdot}143$.

The excess above 22 is doubtless principally due to the departure of nitrous oxide from Boyle's law between atmospheric pressure and a condition of great rarefaction. I hope shortly to be in a position to apply the connection which will allow us to infer what is the ratio of molecular weights according to Avogadro's rule.

1 By Lord Rayleigh, O.M., F.R.S. Abridged from a paper received at the Royal Society on September 1.

2 Or "Scientific Papers," vol. iv. p. 350.

3 "Recherches sur les Gaz." (Paris, 1898.)

4 The lower the temperature below the critical point, the more effective is this procedure likely to be.

1 Roy. Soc. *Proc.*, vol. liii. p. 134, 1893; "Scientific Papers," vol p. 47.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. ERNEST SHEARER, Kirkwall, has been appointed lecturer on agriculture at the Pusa Imperial College, Bengal. This model agricultural college for all India, with a farm of 1300 acres attached, is one of the admirable developments resulting from the appointment two or three years ago of Mr. James Mollison as Inspector-General of Agriculture in India. Mr. Alexander Sangster, Montrose, has been appointed junior assistant with the Aboukir Land Reclamation Co., near Alexandria, Egypt, and Mr. John C. Leslie assistant conservator of forests in southern Nigeria.

THE approach of the new sessions at polytechnics and similar institutes is heralded by the appearance of calendars and prospectuses, several of which have been received within the past few days. At the Birkbeck College, Chancery Lane, the session will commence on Monday, October 3, when an inaugural address will be delivered by Dr. J. E. Mackenzie on "The Influence of Pure Science on Progress." The class-rooms and laboratories of the college will afterwards be open to inspection, and demonstrations will be given. A course in science with practical work has been organised to give complete preparation in metallurgy and mining for those qualifying for the mining profession. It is satisfactory to know that within the last few years valuable reference libraries have been provided for the separate departments of science; these have been aided by grants from the County Council. His Majesty's Treasury recently presented to the college forty-nine volumes of the scientific results of the *Challenger* Expedition.

THREE prospectuses have been received from the South-western Polytechnic, referring respectively to the day college for men and women, day school for boys and girls, and evening classes. The principal of the polytechnic is Mr. S. Skinner. The courses at the day college are arranged to occupy three years. On entering the student has to state whether he wishes to be trained as a mechanical, civil, or electrical engineer, or as a consulting or industrial chemist. In any of these cases he will find mapped out for him a complete course of study, involving laboratory instruction, tutorial work, attendance at lectures, exercises in mathematics, geometrical, mechanical and architectural drawing, and instruction in the workshops.

In the "Announcements" of the Northampton Institute, London, E.C., a table is given showing the courses which should be taken by various classes of technical students. This, as well as the sound advice given in many parts of the prospectus as to aims and methods of study, should be of great assistance in guiding the energies of students in right directions. Among the new developments of the institute are day courses in technical optics. These are believed to be the first complete day courses in technical optics attempted in this or any other country. In mechanical and electrical engineering complete day courses extending over four years are arranged. In mechanical engineering full evening courses for automobiles, their design, construction, and working, are offered. The courses in structural engineering have been re-modelled. The evening courses in electrical engineering have also been re-modelled, the complete course now covering five years.

The Board of Education has issued the following list of candidates successful in this year's competition for the Whitworth scholarships and exhibitions:—Scholarships, 125*l.* a year each (tenable for three years): Walter A. Scoble, London; Herbert G. Tisdall, Bedford; James Cunningham, Glasgow; Archibald D. Alexander, Portsmouth. Exhibitions, 50*l.* (tenable for one year): Sidney R. Dight, Plymouth; Edwin S. Crump, Wolverhampton; Harold H. Perring, Devonport; Sidney H. E. May, Portsmouth; William B. Wood, Sheerness; Alexander R. Horne, Edinburgh; Leslie G. Milner, London; John Wharton, Leeds; Thomas A. Colville, Chatham; Edward L. Macklin, Portsmouth; William D. McLaren, Glasgow; Arthur A. Rowse, Southsea; Arthur Rose, Portsmouth; Andrew Robertson, Fleetwood, Lancs.; Ernest J. Buckton, London; Roderick Ferguson, Sunderland; William Browning, Halifax; William Dawson, Glasgow; Herbert G. Taylor, Oldham; Sydney Moor, Devonport; Harold H. Broughton, Brighton; Robert C. P. Bricknell, Devonport; William E. Dommett, Southsea; John S. Mackay, Liverpool; Harry D. Marlow, Plumstead, Kent; Herbert E. Sothcott, Portsmouth; Sidney G. Winn, London; Samuel W. Orford, Sheerness; Thomas Fell, Bootle; Chauncy H. Sumner, London.

At the annual meeting of the Institution of Mining Engineers, held at Birmingham on September 14, Prof. R. A. S. Redmayne described the courses of instruction and study of the mining department of the University of Birmingham. The full three years' curriculum has been constructed on the principle of giving a thorough grounding in pure science during the first two years (with instruction in the theory and practice of mining), and devoting the third and last year entirely to the application of the scientific knowledge so acquired to engineering—mining, mechanical, civil, electrical, and metallurgical—all specialising and research work being relegated to a post-graduate or fourth year. The first year's work is devoted to such subjects as prospecting and boring, sinking, underground development and systems of working, surface and underground transport of minerals, winding, drainage, ventilation, sorting and screening of minerals, and surveying and planning. During the second year the details of colliery and mine management and mining jurisprudence are considered, in addition to which there is an advanced course in surveying and planning. To the third year is consigned the study of the foreign coal and metal mining conditions, and the dressing and preparation of fuels and ores for the market. There is a summer school of practical mining in every long vacation, the object being to devote several weeks in each year entirely to the detailed study of the plant and methods of working of a particular class of important mines, so that students may see for themselves in actual practice much that they have had described to them in the lecture theatre and class-rooms. An experimental coal-mine has been constructed a few feet below the surface, with which it is connected by a downcast and upcast shaft. The workings, the area of which somewhat exceeds three-quarters of an acre, will be ventilated by a single-inlet Capell fan, driven at 500 revolutions per minute by an electric motor of 20 horse-power, coupled direct; and they will be drained by a small electric pump placed at the bottom of the downcast shaft. The chief use to which this piece of apparatus will be put will be to enable practical instruction to be given in underground surveying and levelling, and connecting surface and underground surveys; and for demonstrating and investigating the peculiarities of mine-ventilation, such as the splitting of air currents and directing their course, the resistance to air currents, the loss of pressure due to friction, and the characteristics of mechanically produced ventilation.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 12.—M. Mascart in the chair.—On the comparative morphography of the cartilaginous cell: Joannes **Chatin.** The author disputes the generally accepted view that the normal shape of the cartilage cell is ovoid or spheroidal in the higher vertebrates, and shows that in cartilage from the badger there are undoubted examples of the stelliform type of cell.—The influence of grafting on the composition of the grape: G. **Curtel.** Clear evidence of differences in physical and chemical composition between grafted and non-grafted grapes has been obtained, and the facts observed explain the more rapid ageing of wines from grafted vines, and also their greater sensitiveness to pathogenic ferments.—Simple traumatic dislocation of the atlas on the axis on a skeleton found in a megalith of Vendée: Marcel **Baudouin.**—Observations on the preceding note: M. **Lannelongue.** The author regards the effects noted as probably due to *post mortem* changes.

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